



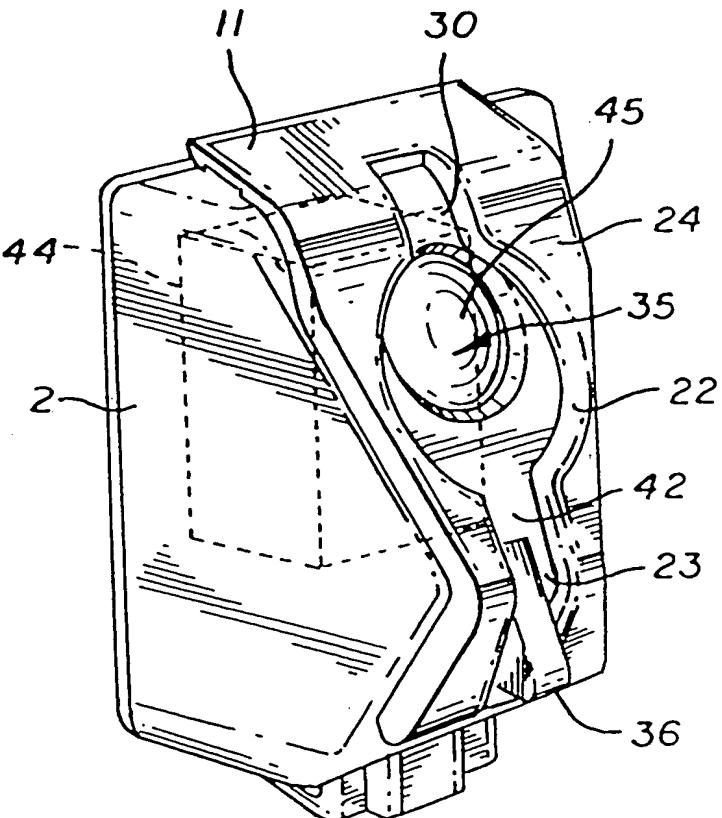
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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(54) Title: VEHICLE MOUNTED OPTICAL ASSEMBLY

## (57) Abstract

An optical assembly for mounting in a vehicle employs a two piece assembly including a bracket (1) having a front surface (24) and a back surface (28) and an optical device (2) having a front surface (39) and a lens element (45) on the front surface. The back surface of the bracket is connected to the vehicle and the front surface of the optical device is removably attached to the back surface of the bracket. The lens element focuses an image through a windshield (31) of the vehicle. In one embodiment of the present invention, the optical device further comprises at least one notch member (37) and a support extension member (36) and the bracket includes an opening (12) and further comprises at least one groove member (19). The at least one notch member is positioned to removably attach to the at least one groove member, and the support extension member is positioned to removably attach to the opening. In one embodiment, the assembly is mounted to the vehicle windshield so that a driver of said vehicle has an unobstructed view of a road.



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## VEHICLE MOUNTED OPTICAL ASSEMBLY

### FIELD OF THE INVENTION

The present invention relates to an optical assembly device for mounting in or on a vehicle. More particularly, the present invention relates to a vehicle optical assembly which can reduce fogging of the optics and be easily removable when mounted to the windshield of a vehicle.

### BACKGROUND OF THE INVENTION

Vehicle mounted cameras and other optical assemblies have typically been employed in specialty applications such as law enforcement, surveillance, television or film applications, etc. In such applications, there is little concern with suitability of the optical assembly and related vehicle mounting system for volume manufacturing. Also, there is relatively little concern for aesthetics or creation of a functional yet unobtrusive design. Rather, the desire is usually to allow a user in the vehicle to have ready access to, and control of, the camera or other device, and an obtrusive design is tolerated if not desired.

Relatively recently, however, systems have been proposed which could be incorporated in virtually all vehicles for safety or driver convenience and which require a camera or other optical assembly to be mounted in the vehicle. For such applications, the optical assembly must be unobtrusive as well as functional. Also, the assembly must be adapted for ease of service or replacement. One example of such a safety application which is very important is a lane departure warning system.

When driving on a roadway, one of the primary requirements for safe transportation is the ability to keep the vehicle in the lane of travel. Of course, in most situations a driver can safely accomplish this task by paying attention to the road. Sometimes, however, a driver fails to keep the vehicle in the desired lane (e.g., the driver falls asleep, the driver is distracted with the radio or other vehicle system, the driver is diverted by other vehicles or roadside

conditions, etc.). Therefore, systems have been proposed which can issue a warning to the driver if the vehicle is proceeding outside of the designated lane.

This type of warning system requires an optical assembly which can be mounted on the vehicle. Other driver assist or safety systems have also been proposed which require a vehicle mounted optical assembly such as a camera. However, implementation of such a vehicle mounted optical assembly presents several problems. First, for safety reasons, the assembly must be mounted in such a way so as not to impede the view of the road to the driver. Further, the device may have to be able to meet vehicle laws regulating obstruction to viewing which are found in various jurisdictions. Second, the housing for the electronics and optical equipment should be easily removable for repair, reprogramming, testing, etc. Third, the optics in the electronics/camera enclosure is negatively affected by any vision obstruction including fogging of the windshield or the lens element of the device. Therefore, a need presently exists for an optical assembly which may be employed in vehicles and which overcomes the above-noted problems.

20

## SUMMARY OF THE INVENTION

The present invention provides an optical assembly which allows the optics and electronics of the system to be removably mounted to a vehicle, for example, to the vehicle windshield in front of the dashboard.

The present invention further provides an optical assembly which can be mounted so as not to obstruct the driver's view of the road.

The present invention further provides a housing for the electronics and optical equipment which is easily removable for repair, reprogramming, testing, etc.

The present invention further provides an electronics/camera enclosure which reduces vision obstruction for an optical system including fogging of the windshield or the lens element of the device.

In accordance with a preferred embodiment of the present invention, an optical assembly for mounting in a vehicle employs a two piece assembly comprising a bracket having a front surface and a back surface and an optical device having a front surface and a lens element on the front surface. The 5 front surface of the bracket is connected to the vehicle and the front surface of the optical device is removably attached to the back surface of the bracket with the lens element configured behind an opening in the bracket. The lens element focuses an image, e.g. of the roadway provided through a windshield of the vehicle onto an imager in the optical device.

10 In one embodiment of the present invention, the optical device further comprises a notch member and a support extension member and the bracket includes an opening and a groove member. The notch member is positioned to removably attach to the groove member, and the support extension member is positioned to removably attach to the opening. In one 15 embodiment, the assembly is mounted to the vehicle windshield so that a driver of said vehicle has an unobstructed view of a road.

The bracket preferably further includes means for preventing fogging of the lens element. In one embodiment of the present invention, the means for preventing fogging can be a channel in the bracket to allow airflow over the 20 lens element. In another embodiment, the means for preventing fogging can be a seal located around the opening for creating a moisture proof seal surrounding the lens element between the bracket and the vehicle windshield.

A more complete understanding of the vehicle mounted optical assembly will be afforded to those skilled in the art, as well as a realization of 25 additional advantages and objects thereof, by a consideration of the following detailed description of the preferred embodiments. Reference will be made to the appended sheets of drawings which will first be described briefly.

#### BRIEF DESCRIPTION OF THE DRAWINGS

30 Fig. 1 depicts an optical assembly mounted in a vehicle according to one embodiment of the present invention;

Fig. 2 is a side view of the optical assembly according to one embodiment of the present invention;

Figs. 3 & 4 are front perspective views of two brackets for an optical assembly according to two embodiments of the present invention;

5 Fig. 5 is a front perspective view of an optical device of the optical assembly according to one embodiment of the present invention; and

Figs. 6 & 7 illustrate the assembly of the two piece optical assembly according to one embodiment of the present invention.

10 10 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention provides an optical assembly which allows the optics and associated electronics of the system to be removably mounted, for example, to the windshield of a vehicle in front of the dashboard. A preferred application is for an optical lane departure warning system, but the invention 15 is not so limited. An active vehicle steering system employing lane boundary detection from an optical assembly including a camera is another application, an example of which is shown in U.S. Patent No. 5,485,378 issued January 16, 1996 to Franke, et al., the disclosure of which is incorporated herein by reference. Many other active and passive vehicle safety and driver 20 assistance applications are also possible, however. In the detailed description that follows, like element numerals are used to describe like elements illustrated in one or more of the above-described figures.

Referring first to Fig. 1, a depiction of the overall architecture of an optical assembly for a lane departure warning system according to one 25 embodiment is shown mounted in front of the dash of a vehicle. The optical assembly of the present invention is preferably a two piece assembly and includes mounting bracket 1 and optical device 2. The optical assembly is not drawn to scale in Fig. 1 and is enlarged relative to the vehicle dash for ease of illustration. Optical device 2 includes a housing as shown which contains the 30 various optical components that are necessary for the optical monitoring system, e.g., a lane departure warning system in a presently preferred

application, and may preferably be a digital camera. Optical device 2 is shown in the operating position as inserted in bracket 1. However, the two piece nature of the optical assembly allows optical device 2 to be easily removed from bracket 1 for repair or replacement, programming, testing, etc.

- 5 Both bracket 1 and optical device 2 can be made of any suitable material, including metal, however a hard plastic is presently preferred.

Bracket 1 is illustrated in Figure 1 attached to windshield 31 of vehicle 3 in front of dashboard 32, inside vehicle 3. In other embodiments of the present invention, bracket 1 can also be attached to other locations of vehicle 10 3, such as on the dashboard or roof, or the exterior such as behind a transparent panel in the vehicle grill, etc. In addition, while vehicle 3 is shown in one embodiment as being a truck, the optical mounting assembly of the present invention can be employed for other vehicles, such as automobiles or motorcycles.

15 The optical assembly, including bracket 1 and optical device 2, is shown in a side view in Fig. 2 according to one embodiment of the present invention. Optical device 2 is shown in the operating position inserted in mounting bracket 1. Bracket 1 is fixedly attached to windshield 31, for example, by use of an adhesive 41. As shown in this embodiment, adhesive 20 41 is situated to create a tight seal between windshield 31 and the front surface 14 of bracket 1. Flexible cable 4 connects to electrical socket 47 via a mated plug so that the two parts can be easily separated to remove optical device 2 for repair, reprogramming, etc. Flexible cable 4 contains leads which route signals such as vehicle status (e.g., speed, turn signal status, etc.), 25 disable inputs, and warning/stereo mute signals between optical device 2 and the vehicle 3 through dashboard 32. Flexible cable 4 also provides power from the vehicle power supply to optical device 2. A need for power leads in flexible cable 4 could be completely eliminated by including a battery (not shown) in or on optical device 2. Also, while some or all of the image 30 processing and warning control circuitry and software are preferably configured inside optical device 2, this electronics could optionally be

configured outside of the housing of optical device 2. Normally, some wiring from optical device 2 will be required however, to avoid providing audible warning amplification circuits and speakers in device 2.

Figs. 3 & 4 show two embodiments of the bracket of the present invention. These two embodiments provide different solutions to the problem of fogging of the lens of the optical device. Which approach is preferred will depend on the combination of the vehicle dash and windshield configuration and whether a suitable airflow is adjacent to the assembly.

As shown in Fig. 3, bracket 1 generally is an opened up U-shaped device comprising a base 15 and two arm members 16 and 17. Base 15 has a flat front surface 14 and a back surface 18. In operation, front surface 14 is fixedly attached to windshield 31. This attachment can be accomplished by any suitable means, including glue or adhesive tape. Such attachment means also preferably serves as a seal which completely surrounds opening 12 and prevents moisture entering. Alternatively, a separate seal, such as an annular gasket may be employed. If formed of a suitable mastic material, such gasket could also affix the bracket to the windshield. Also, an annular seal 41 is shown located on back surface 18 of bracket 1 and encircles circular opening 12. Annular seal 41 can be made of plastic or rubber material and is employed to create a seal between back surface 18 and optical device 2 in order to prevent fogging of the lens element of optical device 2. When optical device 2 is seated in position against bracket 1, circular opening 12 allows optical device 2 to receive light for imaging the roadway for lane detection, through windshield 31. Elongated opening 13 and groove members 19 are located so as to provide an anchoring mechanism for holding optical device 2 in place against bracket 1, as described below.

As shown in Fig. 4, bracket 11 is another embodiment of the bracket for the optical mounting assembly of the present invention. Bracket 11 generally also is an oblique U-shaped device comprising a base 25 and two arm members 26 and 27. Base 25 has a front surface 24 and a back surface 28. In operation, front surface 24 is fixedly attached to windshield 31. This

attachment can be accomplished by any suitable means, including glue or adhesive tape. Optical device 2 is removably attached to bracket 11 against back surface 28. Base 25 also has a circular opening 22. When optical device 2 is seated in position against bracket 1, circular opening 22 allows 5 optical device 2 to receive an image for lane detection through windshield 31. Elongated opening 23 and groove members 29 are located so as to provide an anchoring mechanism for holding optical device 2 in place against bracket 11. Finally, openings 30 & 42 are located so as to create a channel to allow airflow from the vehicle air blowers to pass through bracket 11 and across the 10 lens element of housing component device 2 to prevent fogging of the lens element.

In Fig. 5, one embodiment of optical device 2 is shown. Opening 35 is located on front surface 39. A lens element 45 is located within or behind opening 35. Imager 44 is shown by dashed lines within optical device 2 for 15 illustration purposes. In operation, for example, in a preferred embodiment of a lane departure warning system, an image of the roadway ahead of the vehicle is formed by the lens element 45 and focused on imager 44 to detect lane markers on the roadway.

Also, as shown in Fig. 5, optical device 2 includes notches 37 and 20 support extension 36 which are used to secure optical device 2 to bracket 1, as described below.

Fig. 6 depicts the operation of mounting optical device 2 to bracket 1 (shown in Fig. 3). In this embodiment of the present invention, bracket 1 is shown fixedly attached to windshield 31. Optical device 2 is then mounted to 25 bracket 1 at two connection points as follows: 1) support extension 36 is placed inside elongated opening 13, and 2) notches 37 are locked into groove members 19. When in the operating position, front surface 39 of optical device 2 is seated against back surface 18 of bracket 1. In addition, in this embodiment of the present invention, annular seal 41 is shown 30 surrounding opening 12. Annular seal 41 can comprise any suitable material such as rubber. In operation, sealing device 41 creates a seal around the

lens element located within opening 35 of optical device 2 in order to prevent fogging of the lens element. It will be appreciated that the optical device may thus be easily mounted to, and removed from, bracket 1 to facilitate repair or replacement, adjustment, etc.

5 Fig. 7 shows the optical assembly of the present invention in the operating position according to another embodiment of the bracket. Optical device 2 is seated within bracket 11 (as shown in Fig. 4) and removably attached at two connection points as follows: 1) support extension 36 is placed inside elongated opening 23, and 2) notches 37 are locked into 10 grooves 29 (not shown). Front surface 24 of bracket 11 can be fixedly attached to windshield 31 of vehicle 3. In operation, the lens element 45, which is located within opening 35 of optical device 2, forms an image, e.g., the roadway ahead of the vehicle from light provided through circular opening 22 of bracket 11 and windshield 31. Imager 44 receives the roadway images 15 and provides digital image data corresponding to these images to be used, e.g., for lane detection. Also as shown, openings 30 & 42 in bracket 11 are located so as to create a channel to allow airflow from a vehicle air blower to pass through bracket 11 and across the lens element of optical device 2 to prevent fogging of the lens element.

20 Therefore, both embodiments of the mounting bracket allow the optical device 2 to be securely mounted yet easily removed. Also, the problem of fogging of the lens element of the optical device is avoided. Furthermore, the overall assembly is unobtrusive and may easily fit behind the dash of most vehicles.

25 Having thus described a preferred embodiment of a vehicle mounted optical assembly, it should be apparent to those skilled in the art that the above noted and additional advantages of the within system have been achieved. It should also be appreciated that various modifications, adaptations, and alternative embodiments thereof may be made within the 30 scope and spirit of the present invention. The invention is thus not limited to the illustrated embodiments, but is defined by the following claims. For

example, the optical assembly need not be mounted to the windshield of a vehicle, but may be mounted elsewhere. Also, the bracket may be integrated into a position of the vehicle as part of the vehicle design.

## CLAIMS

What is Claimed is:

- 5        1. An optical assembly for mounting in or on a vehicle, the assembly comprising:
  - a bracket having a front surface, a back surface, and an opening passing from the front to back surface, wherein said front surface of said bracket is adapted to be mounted to said vehicle; and
- 10      an optical device having a front surface and an optical element, wherein said front surface of said optical device is removably attached to said back surface of said bracket with the lens element configured behind the opening of the bracket;
  - and wherein said bracket further comprises means for preventing fogging of said optical element.
- 15      2. The optical assembly as recited in Claim 1, wherein said optical device further comprises at least one notch member and a support extension member, and wherein said bracket includes a mounting opening and at least one groove member, and wherein said at least one notch member is positioned to removably attach to said at least one groove member, and said support extension member is positioned to removably fit within said mounting opening.
- 20      3. The optical assembly as recited in Claim 1, wherein said assembly has a partially wedge-shaped configuration to allow the assembly to be mounted to said vehicle windshield between the vehicle dash and the windshield so that a driver of said vehicle has an unobstructed view of a road.
- 25

4. The optical assembly as recited in Claim 1, wherein said means for preventing fogging is a channel located in said bracket to allow airflow over said optical element.

5 5. The optical assembly as recited in Claim 1, wherein said means for preventing fogging is a sealing device located around said opening in the bracket for creating a seal between said lens element and said vehicle windshield.

10 6. The optical assembly as recited in Claim 1, wherein said front surface of said bracket is mounted to said vehicle windshield.

7. The optical assembly as in Claim 1, wherein the optical element is a lens element.

15 8. A method for mounting an optical device having an optical element on a vehicle, comprising the steps of:

providing a bracket having a front surface, a back surface and an opening between the front and back surface;

20 mounting said front surface of said bracket to said vehicle; and  
mounting the optical device having a front surface and a lens element on said front surface, wherein said front surface of said optical device is removably attached to said back surface of said bracket;  
and wherein said bracket further comprises means for preventing  
25 fogging of said optical element.

9. The method for mounting an optical device as recited in Claim 8, wherein said optical device further comprises at least one notch member and a support extension member, and wherein said bracket includes an opening  
30 and further comprises at least one groove member, and wherein said at least one notch member is positioned to removably attach to said at least one

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groove member, and said support extension member is positioned to removably attach to said opening.

10. The method for mounting an optical device as recited in Claim 8,  
5 wherein said assembly has a partially wedge-shaped configuration to allow  
the assembly to be mounted to said vehicle windshield between the vehicle  
dash and the windshield so that a driver of said vehicle has an unobstructed  
view of a road.

10 11. The method for mounting an optical device as recited in Claim 8,  
wherein said means for preventing fogging is a channel located in said  
bracket to allow airflow over said lens element.

12. The method for mounting an optical device as recited in Claim 8,  
15 wherein said bracket includes an opening and wherein said image provided  
by said lens element passes through said opening, and wherein said means  
for preventing fogging is a sealing device located around said opening for  
creating a seal between said lens element and said vehicle windshield.

20 13. The method for mounting an optical device as recited in Claim 8,  
wherein said front surface of said bracket is mounted to said vehicle  
windshield.

FIG. 1

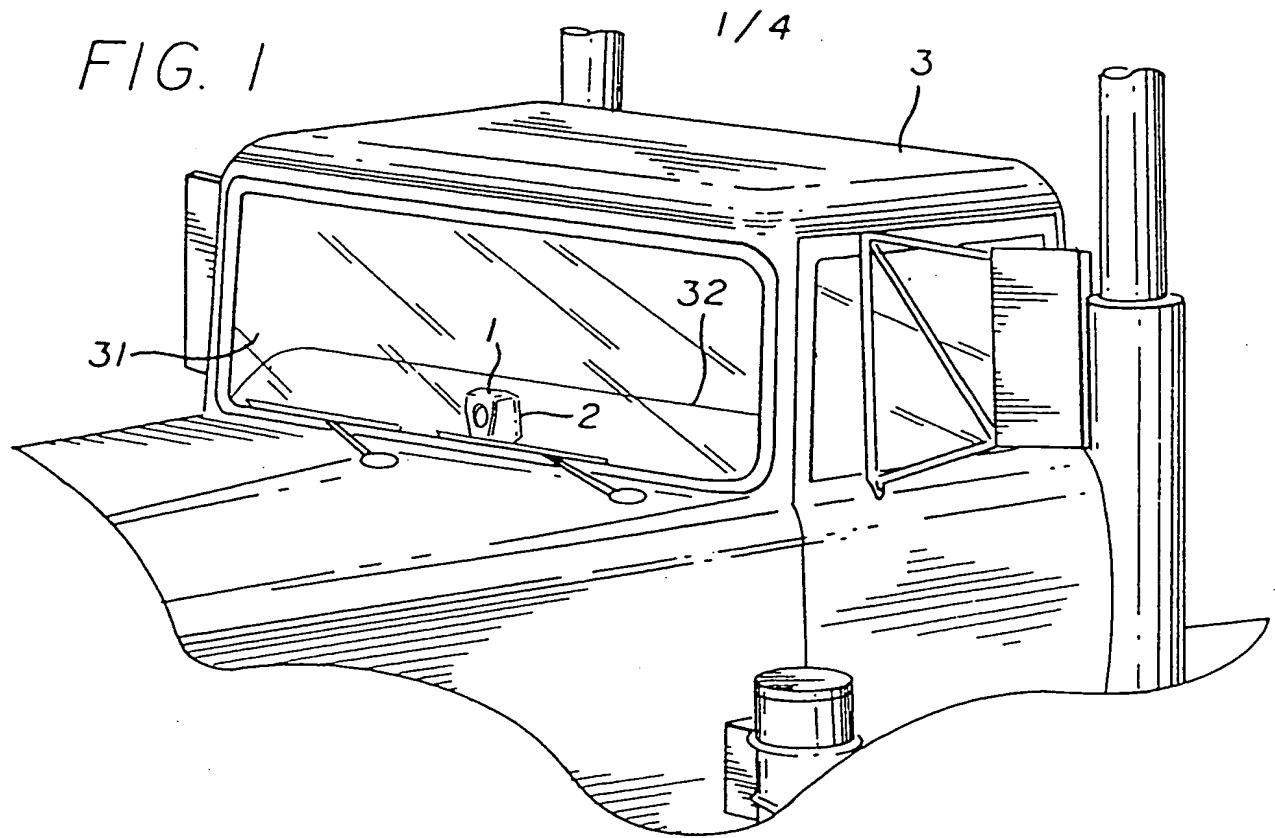
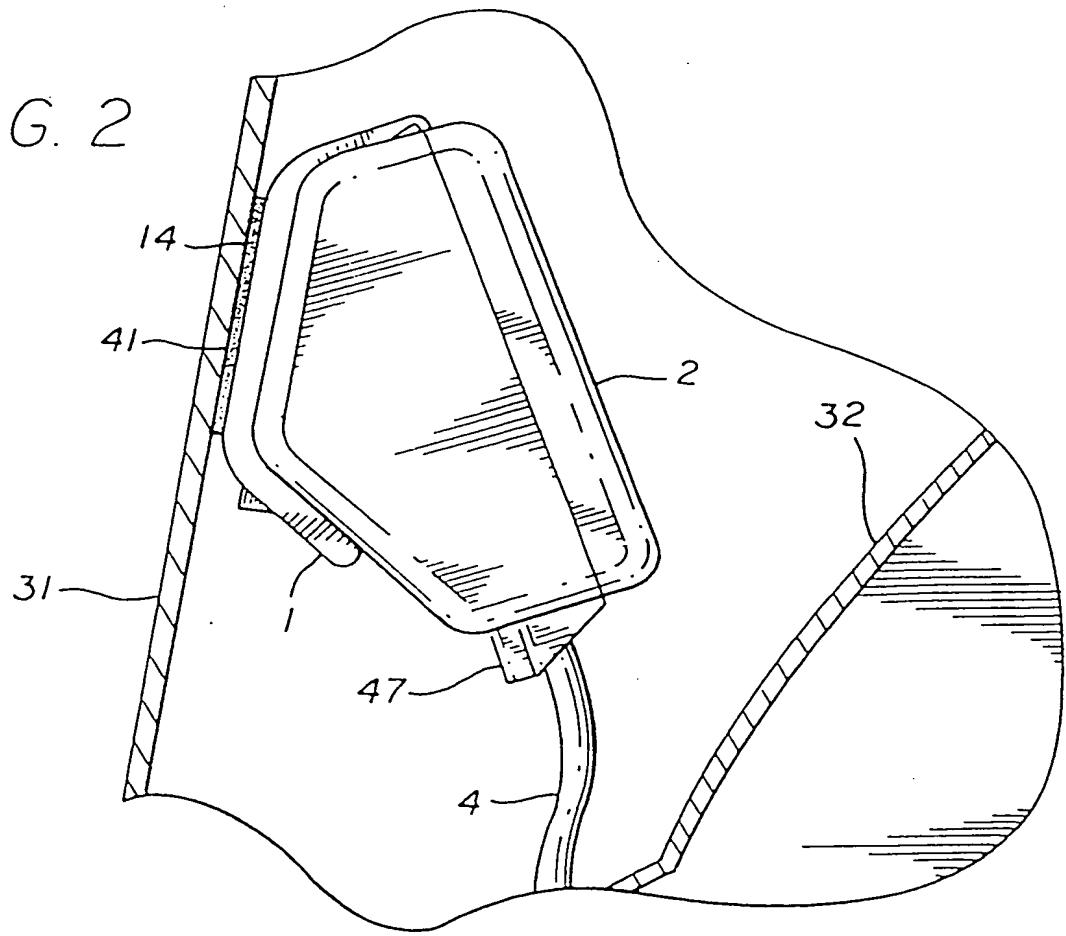
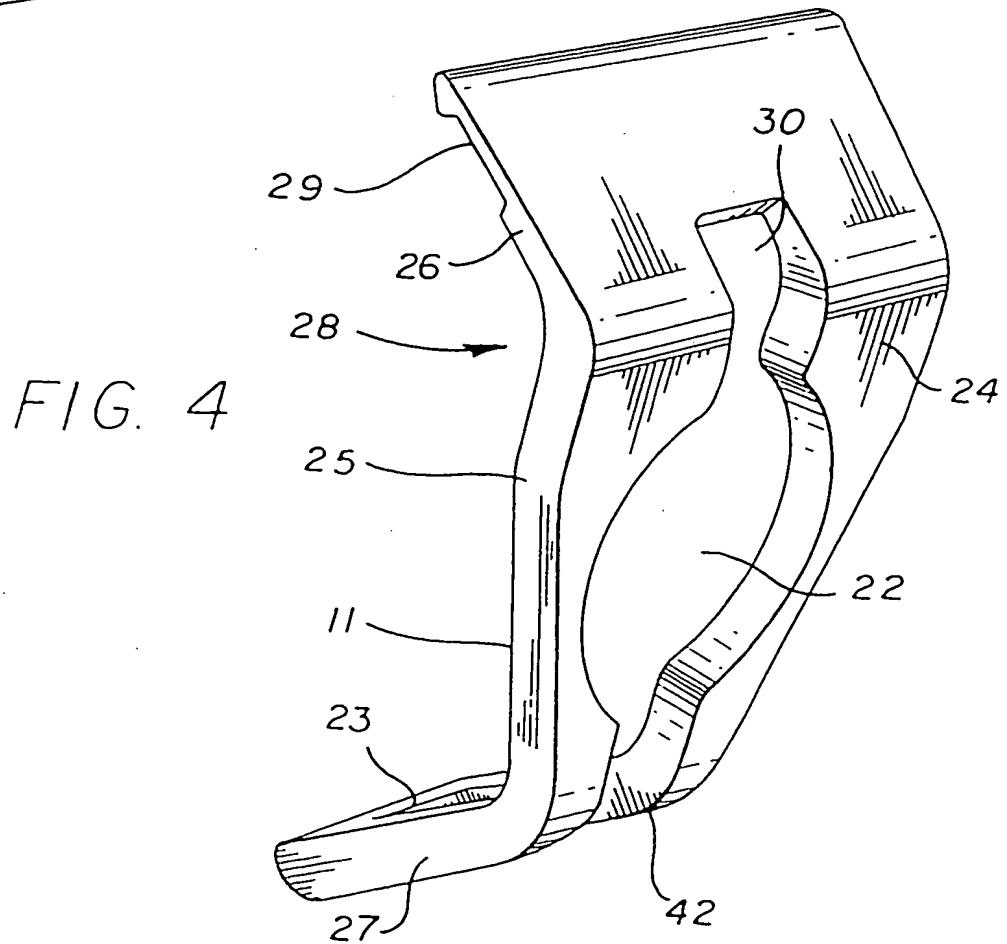
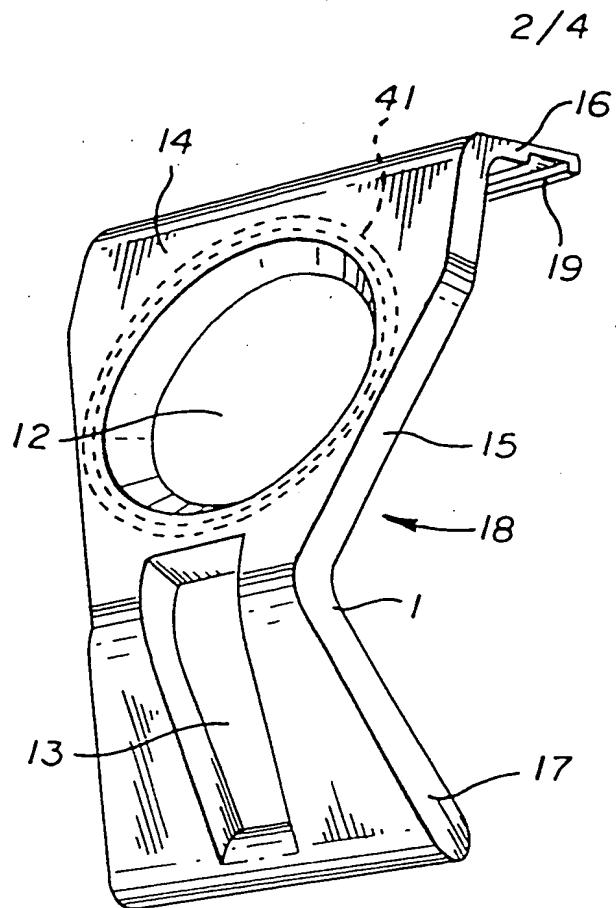
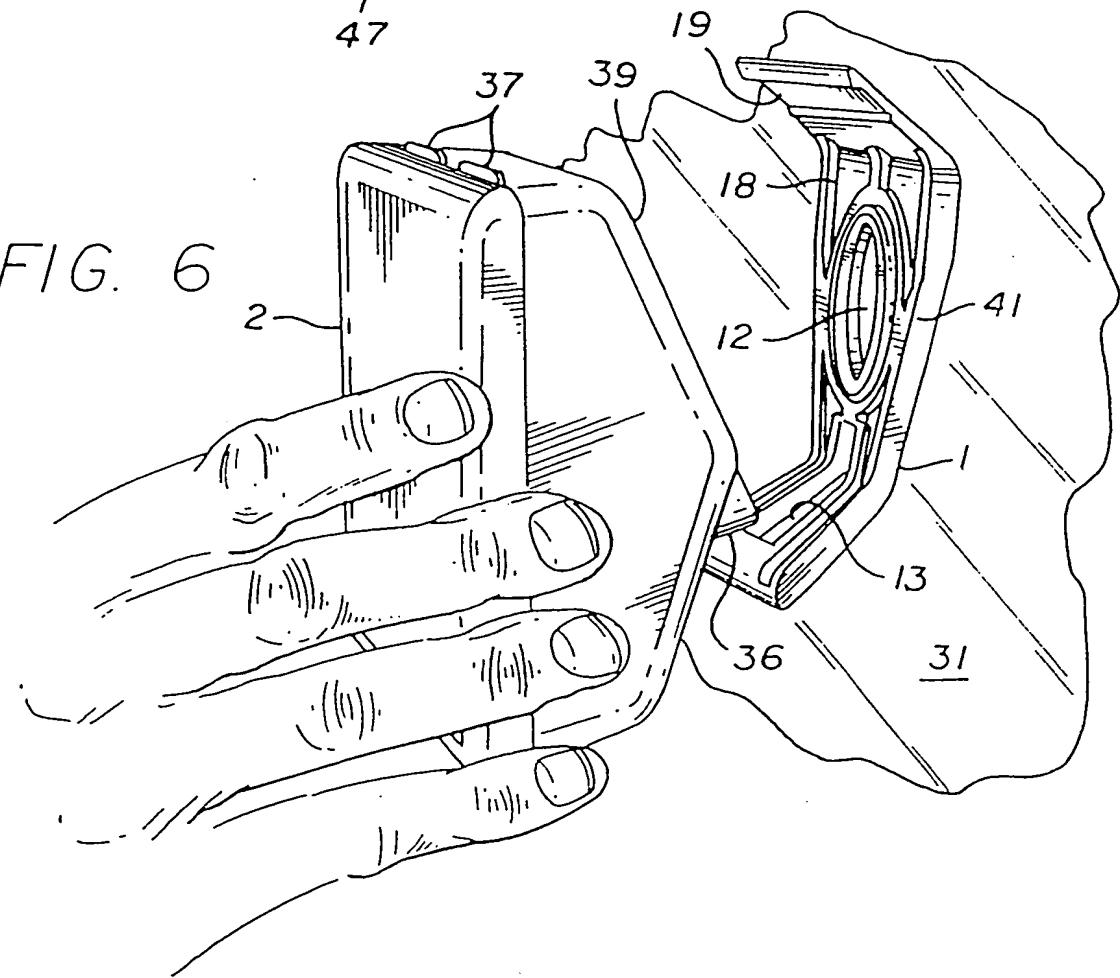
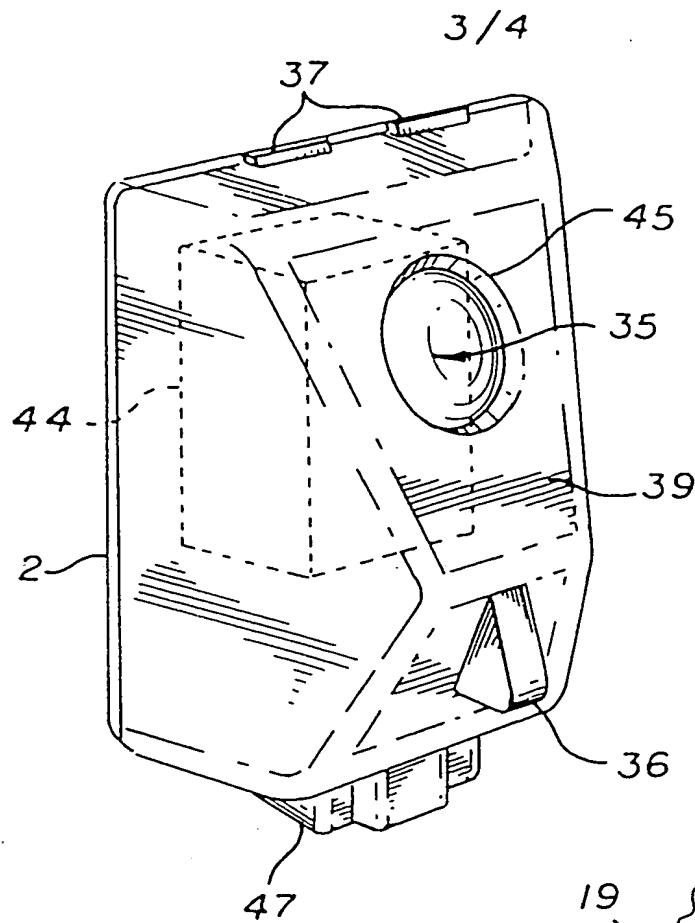


FIG. 2



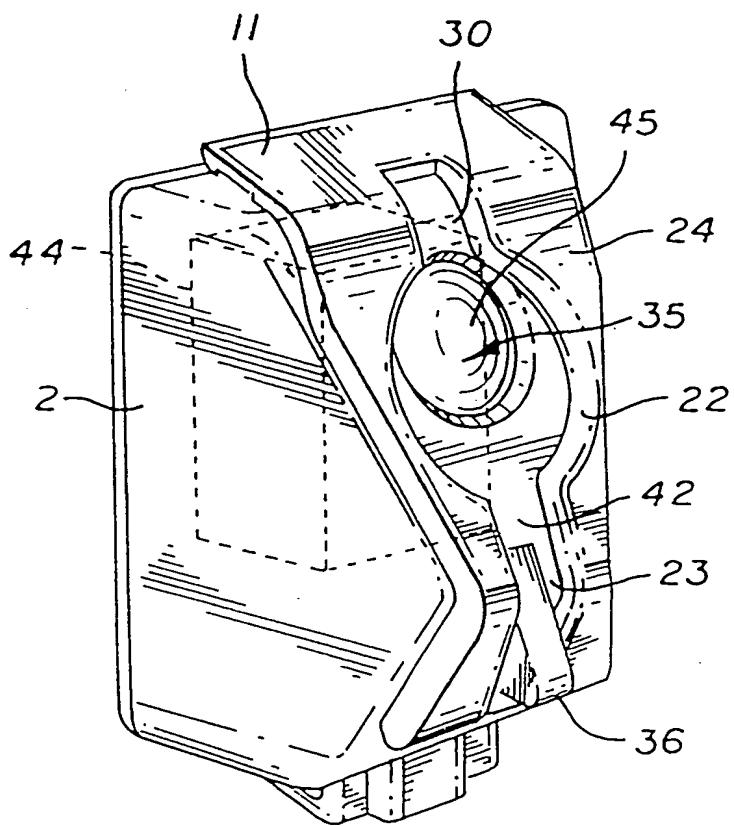




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FIG. 7



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US99/04364

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A47F 7/14

US CL : 248/475.1

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 248/475.1, 222.51, 222.11, 309.1, 205.3, 223.41, 224.51, 224.8, 300, 309.1, 316.1; 359/509; 296/84.1; 340/901

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,485,378 A (FRANKE et al) 16 January 1996 (16.1.96), see entire document.	1-13
A	US 5,667,176 A (ZAMARRIPA et al) 16 September 1997 (16.9.97), see entire document.	1-13
A	US 4,576,320 A (MEAD) 18 March 1986 (18.3.86), see entire document.	1-13
A	US 3,343,772 A (HOWELL et al) 26 September 1967 (26.9.67), see entire document.	1-13
A	US 5,743,991 A (TEDER et al) 28 April 1998 (28.4.98), Fig. 2.	1-13
A	US 4,863,130 A (MARKS, Jr.) 05 September 1989 (31.5.88), entire document.	1-13



Further documents are listed in the continuation of Box C.



See patent family annex.

*A*	Special categories of cited documents document defining the general state of the art which is not considered to be of particular relevance	*T*	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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Date of the actual completion of the international search

11 JUNE 1999

Date of mailing of the international search report

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FIG. 1

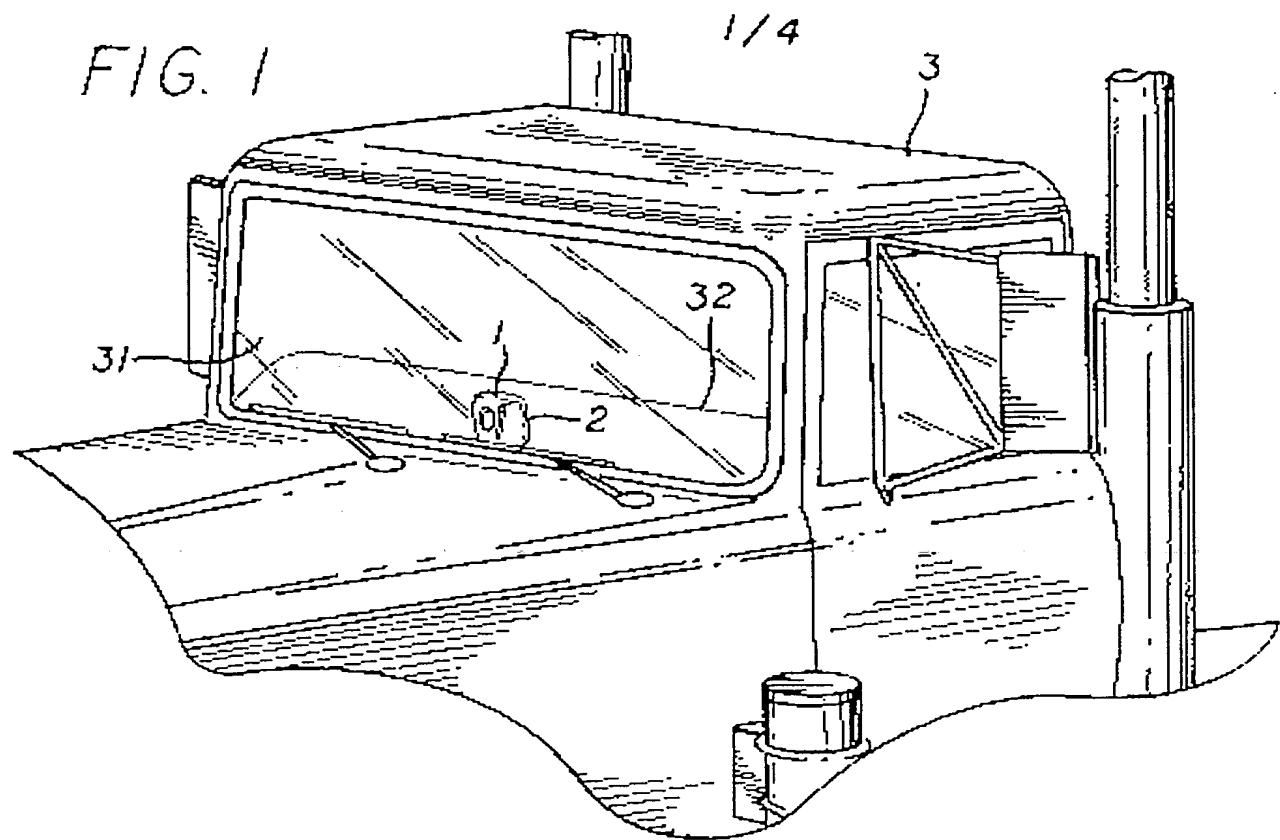
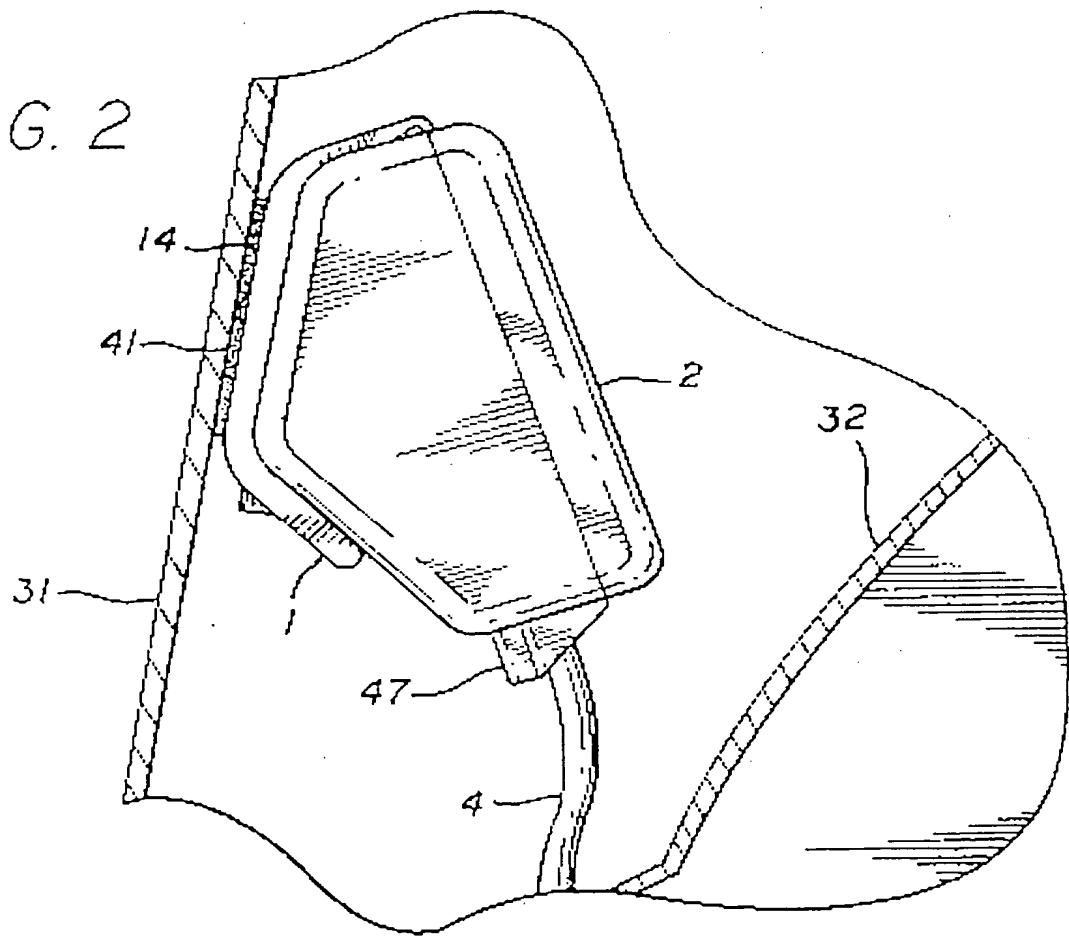


FIG. 2



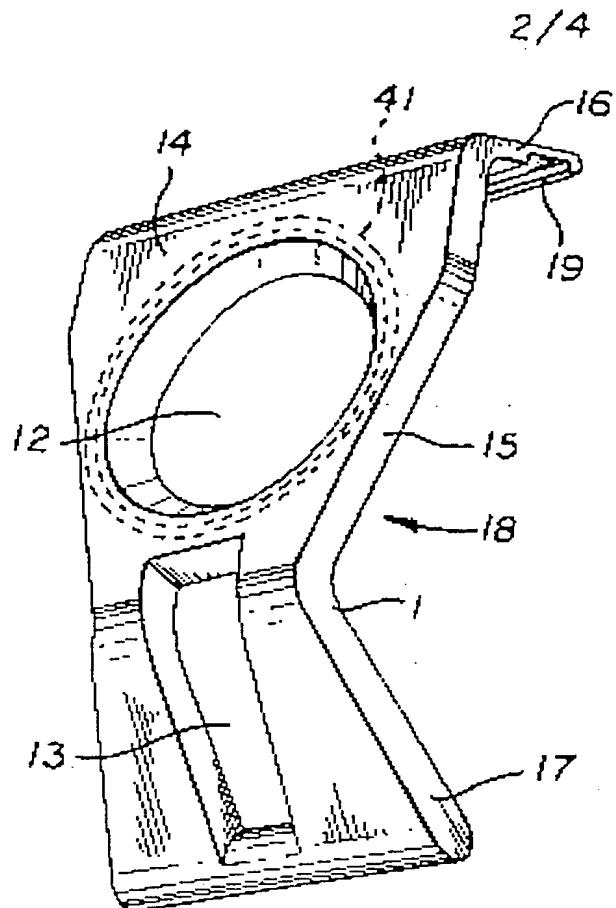


FIG. 3

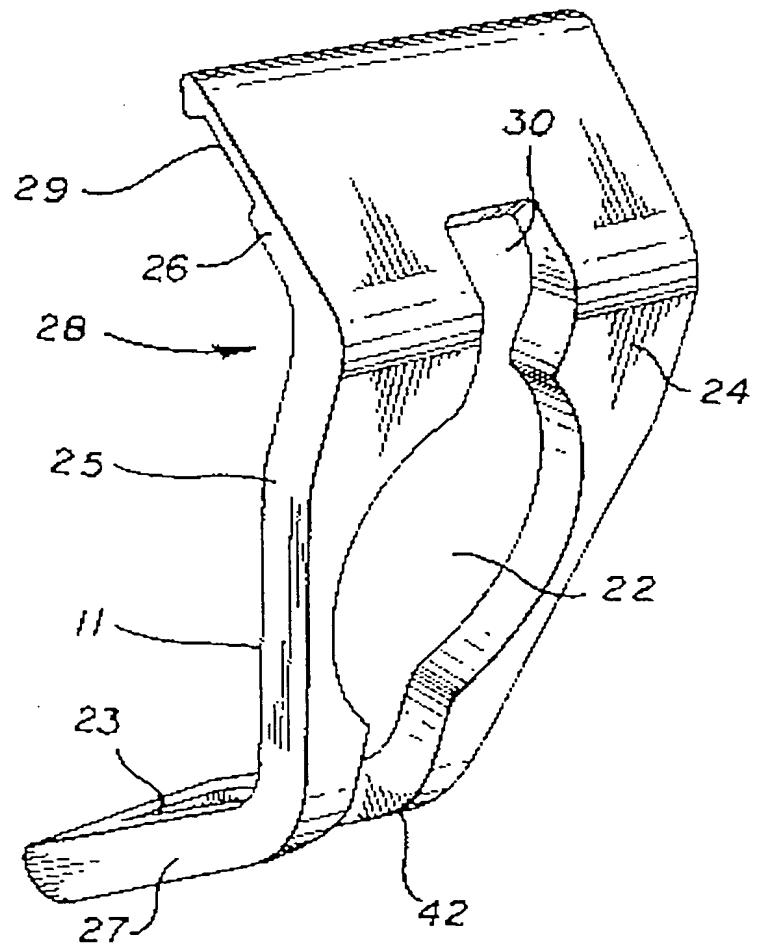
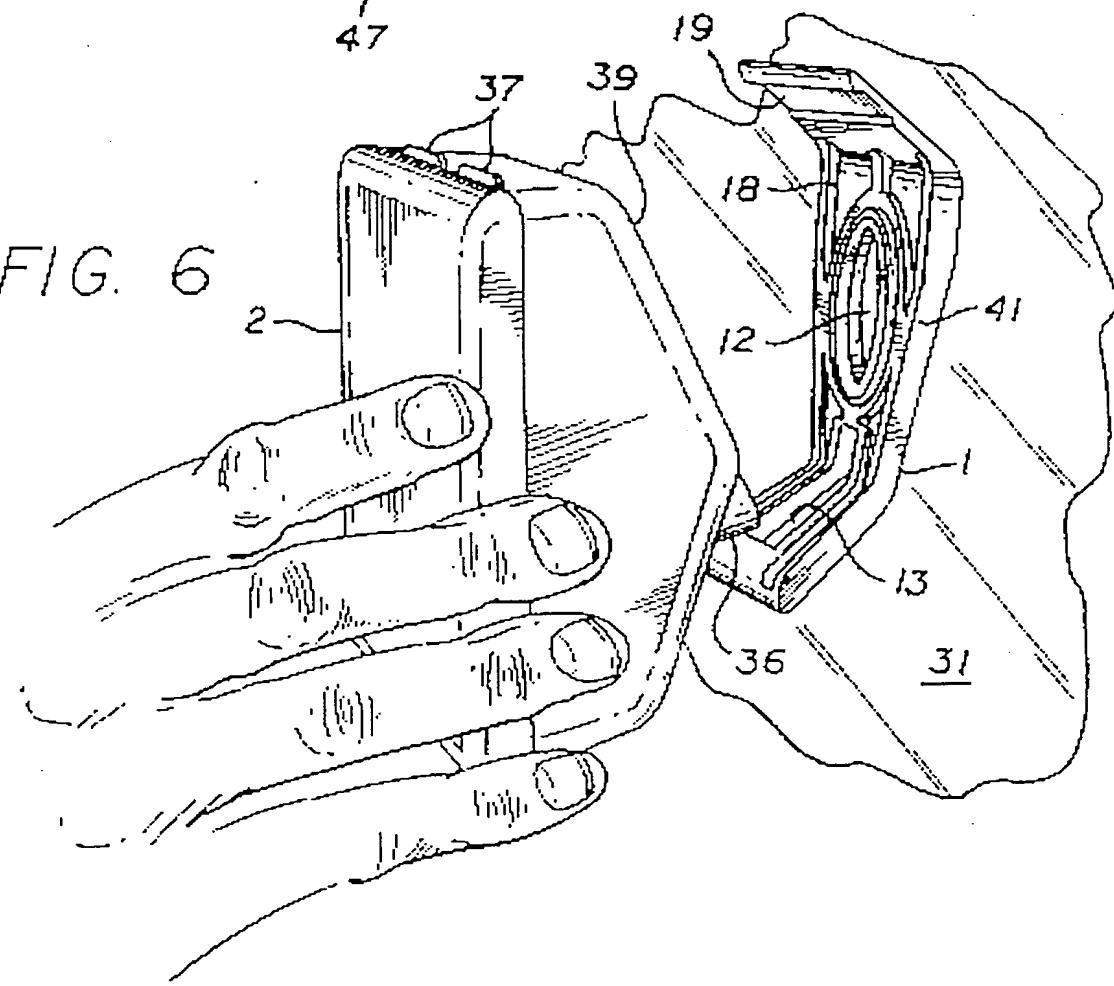
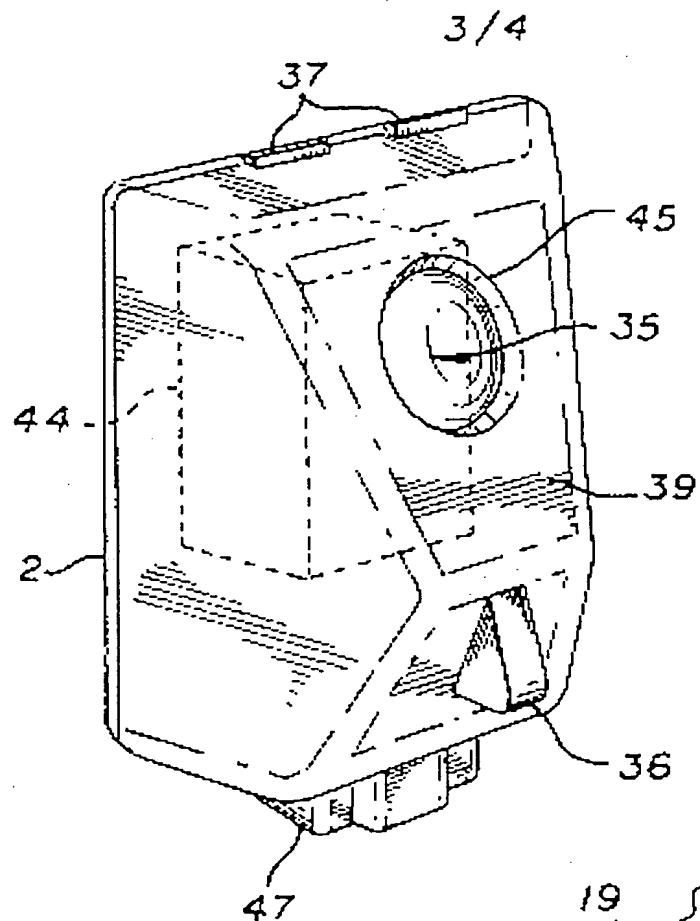


FIG. 4



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FIG. 7

